

VŠB – Technical University of Ostrava
Faculty of Electrical Engineering and Computer Science
Department of Computer Science

Advertising server

Inzertní server

Bachelor Thesis Assignment

Student: **Pavel Jurásek**

Study Programme: B2647 Information and Communication Technology

Study Branch: 2612R025 Computer Science and Technology

Title: **Advertising Server**
Inzertní server

The thesis language: English

Description:

The aim of the work is to create a modern web portal focused on advertising among users.

1. Analyze and describe the current state on the market of advertisement servers, not limited only to Czech Republic.
2. Design and describe concept of general advertisement server. Focus on contemporary trends and possibilities of internet applications (mobile/responsive version, customization, etc.).
3. Implement designed system using modern approaches and technologies.
4. Evaluate the final system, its potential deployment and further development.

References:

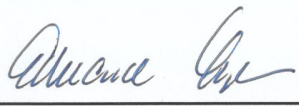
- [1] Robin Nixon: Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5 (Learning Php, Mysql, Javascript, Css & Html5), O'Reilly, 2014, ISBN: 978-1491918661
- [2] Sasha Vodnik: HTML5 and CSS3, Illustrated Complete, Course Technology, 2015, ISBN: 978-1305394049
- [3] Jason Beard: The Principles of Beautiful Web Design, SitePoint, 2014, ISBN: 978-0992279448

Extent and terms of a thesis are specified in directions for its elaboration that are opened to the public on the web sites of the faculty.


Supervisor: **Ing. Michal Radecký, Ph.D.**

Date of issue: 01.09.2015

Date of submission: 29.04.2016


doc. Dr. Ing. Eduard Sojka
Head of Department




prof. RNDr. Václav Snášel, CSc.
Dean of Faculty

I hereby declare that this bachelor's thesis was written by myself. I have quoted all the references I have drawn upon.

Ostrava, April 29, 2016



.....

Hereby I would like to express my gratitude to my brother Vojtěch Jurásek for giving me advices in designing user interface, to my thesis supervisor Michal Radecký for guiding me and to other people who helped me with little decisions in SW design. This thesis wouldn't came to light without Your help.

Abstrakt

Tato bakalářská práce se zabývá trhem inzertních serverů v České Republice i v zahraničí. Hlavním cílem této práce je navrhnout a naimplementovat vlastní inzertní server založený na poznatcích získaných při výzkumu trhu. V první části práce analyzuji čtyři populární inzertní servery v České Republice: aukro.cz, avizo.cz, hyperinzerce.cz a annonce.cz, a dva Panamské inzertní servery encuentra24.com a olx.com.pa. Při výzkumu se zaměřuji na funkcionalitu a obchodní plán. V praktické části provádím analýzu, návrh a samotnou implementaci systému. Řešení je založeno na populárním českém frameworku Nette. Výsledkem praktické části je koncept inzertního serveru, kde mohou být publikovány realitní nabídky.

Klíčová slova: inzertní server, Nette, PHP, HTML5, UI

Abstract

This thesis discusses and analyzes a market of advertising servers both in the Czech Republic and abroad. The main goal is to design and implement custom advertising server based on knowledge from the market research. In the first part of the thesis I analyze four popular advertising servers in the Czech Republic: aukro.cz, avizo.cz, hyperinzerce.cz and annonce.cz; and two Panamanian advertising servers encuentra24.com and olx.com.pa. The functionality offered to the clients and visitors, and business model was discussed. In practical part the analysis, the design and the implementation itself were done. The solution is based on popular Czech framework for PHP, Nette. The result of the practical part is a proof of concept advertising server where real estates can be advertised.

Key Words: advertising server, Nette, PHP, HTML5, UI

Contents

List of symbols and abbreviations	8
List of Figures	9
List of Tables	10
1 Introduction	12
2 E-commerce	13
2.1 Categories	13
2.2 Advertising server	15
3 Market research	16
3.1 Aukro	16
3.2 Avizo	18
3.3 Hyperinzerce	20
3.4 Annonce	21
3.5 OLX	23
3.6 Encuentra24	24
3.7 Comparison	26
4 Design	27
4.1 Account	30
4.2 Front	34
4.3 Admin	38
5 Technologies	39
5.1 PHP, Nette	39
5.2 Doctrine	40
5.3 MariaDB	41
5.4 RabbitMQ	41
5.5 HTML5	41
5.6 Other technologies	41
6 Implementation	43
6.1 Registration	43
6.2 Create Advertisement - Multi-step process	46
6.3 Category tree management	47
6.4 Subjects	48

6.5 UI	49
7 Evaluation and further development	50
8 Conclusion	51
References	52
Appendix	54
A List of contents - CD	55

List of symbols and abbreviations

AMQP	– Advanced Message Queuing Protocol
API	– Application Programming Interface
B2B	– Business to Business
B2C	– Business to Consumer
C2B	– Consumer to Business
C2C	– Consumer to Consumer
CRUD	– Create, Read, Update, Delete
CSRF	– Cross-Site Request Forgery
CSS	– Cascading Style Sheets
CTO	– Chief Technology Officer
CZK	– Czech Koruna
DBAL	– Database Abstraction Layer
DTO	– Data Transfer Object
GPL	– General Public Licence
HTML	– Hypertext Markup Language
JSON	– JavaScript Object Notation
ORM	– Object-Relational Mapping
PAB	– Panamanian Balboa
PHP	– PHP Hypertext Preprocessor
SMS	– Short Message Service
SSL	– Secure Socket Layer
UI	– User Interface
URL	– Unified Resource Locator

List of Figures

1	Aukro	16
2	Avizo	18
3	Hyperinzerce	20
4	Annonce	21
5	OLX	23
6	Encuentra24	24
7	Use case diagram	27
8	Domain model	28
9	Statechart diagram	29
10	Activity diagram	29
11	Account - Login page	31
12	Account - List of classifieds	32
13	Account - Adding a classified	33
14	Account - Message detail	34
15	Front - Advertisements list	35
16	Front - Filtered advertisements list	36
17	Front - Advertisement detail	37
18	Doctrine package chain	40
19	RabbitMQ principle example	41
20	Account - Registration	43
21	Wizzard - navigation	47
22	Responsive layout on mobile devices	49

List of Tables

1	Comparison of advertising servers	26
---	---	----

Listings

1	RegistrationService class declaration	43
2	RegistrationService::isEmailRegistered definition (simplified)	44
3	RegistrationService::registerViaEmail definition (simplified)	44
4	onNewRegistration event handler	45
5	RegistrationMailer consumer (simplified)	45
6	RegistrationService::registerViaFacebook definition (simplified)	45
7	Wizzard configuration	46
8	Passing data from subcomponent to Wizzard	47
9	Checking duplicate categories under the same parent (simplified)	47
10	Factory for creating a form based on category	48
11	Factory for creating a persister based on category	48

1 Introduction

This bachelor thesis discusses e-commerce in its various forms that nowadays covers many methods of Internet trading. Advertising servers, which allow to publish basically any classified, are discussed in more details. Advertising server is an internet service which is supposed to interconnect people who want to get rid of needless objects with people who are in need of some of these objects. In practice there are many more use cases such as advertising of services or business classifieds.

In theoretical part I cover a background of Internet shopping, go through seller-buyer scenarios and define the term “Advertising server” in detail. Overview of current market of advertising servers both in the Czech Republic and abroad follows. I go through the servers and describe what services the server offers to the buyers and to the sellers, point out some unique or interesting facts and elaborate on a business model that those servers apply.

Practical part covers design and implementation of a new advertising server that benefits from knowledge obtained during the research in theoretical part. Every advertising server is very valuable source of inspiration in terms of usability, design and monetization. Considering the enormous amount of subjects that can be advertised, the practical part implements only a category of real estates.

I would like to point out that this system is part of real business project and it will be further maintained and developed. There are already too many advertising servers in developed countries (North America, Western Europe), but there are very little advertising servers in developing countries. Moreover every country or at least region has its own specifics. Therefore this project is customized for deployment in region of South America.

2 E-commerce

Internet shopping have gone through a rapid evolution since its beginning in early 1990's. First e-shops were selling books and music [1]. Thanks to technology to secure internet communication (SSL) the online shopping became more trustworthy. In 1995 Amazon and eBay, successful e-commerce companies, which are still on market, being valued \$268.4B and \$29B respectively [2], were founded. Vltava.cz and computerpress.cz, both of which can be considered the first Czech e-shops [3]; avizo.cz [4], one of the first advertising servers; and also seznam.cz, influential Czech portal currently offering many services including sbazar.cz, sauto.cz, sreality.cz and zbozi.cz, were founded in the year of 1996. With the beginning of the new millennium, a number of e-commerce websites and a number of Internet users in the Czech Republic grew gradually. Since then people have started to perceive the world of online shopping and advertising as equivalent to the traditional conception in physical world.

Popularity of electronic shopping gradually grows every year in the Czech Republic. According to the Heureka.cz's (Czech biggest online shopping assistant and price tracker [5]) report for the year 2015, an annual circulation of e-commerce grew by 20% to 81 billions CZK. Thereby, e-commerce takes 8.1% of a total retail circulation, 1% more than the previous year [6].

2.1 Categories

Relations between sellers and buyers can be divided into four categories:

- Business to business (B2B)
- Business to consumer (B2C)
- Consumer to consumer (C2C)
- Consumer to business (C2B)

2.1.1 B2B

One company makes a transaction with another company [7]. Typical scenarios are:

- A supplier provides material for processing in another company, e.g. electronics manufacturer buying electronic components,
- a business paying for services provided by another business, e.g. an IT company having an external accountancy firm (also called outsourcing: services are carried out by another firm rather than having their own department),
- business reselling products made by other producers, e.g. chain stores selling food made by food producers.

Common consumer might not realize that B2B is the category where more than a half of revenues are generated. It is expected that B2B market will be twice as big as B2C market [8].

2.1.2 B2C

B2C is the biggest part of e-commerce in volume. It is form of selling products and services directly to the consumers [7]. Examples follow:

- Online mediation of transaction, publication of information, sale or rent of a software - business offers services to consumers,
- sale of goods typically with online payment - e-shops as we know them, the most common mean of B2C e-commerce,
- giving support to and receiving feedback from visitors.

An example of B2C is a tire manufacturer selling its product to automobile repair shops and tire service centers.

2.1.3 C2C

[9] Consumer offers his/her services or goods directly to another consumer. Businesses can profit from C2C too as there must be some platform for connecting both sides. Such online market places might be of two types (or possibly combined together):

- Classifieds,
- online auctions.

Examples of such C2C platforms are eBay and Amazon. There are Aukro, Avizo, Sbazar, Vinted and many others in the Czech Republic.

2.1.4 C2B

[10] Businesses are those who consume services offered by individual consumers. Representatives of this model might be:

- Consumers writing a review about business's product, e.g. fashion blogger reviewing new collection of a fashion brand,
- reverse auction (demand collection model) giving a company rough estimate of the market and approximate value of their product or service.

2.2 Advertising server

Advertising server is a platform and meeting point for both businesses and consumers. Depending on the provider, such advertising server may support one of categories, combination of them or even all of the e-commerce categories discussed above. Some are focused on particular service or product, other have broader range of offered products and services.

For businesses, advertising server may be just a supporting channel of communication with the visitors in addition to their own web presentation. On the other hand, such advertising server might save a lot of costs for developing custom solution. A business must consider certain “rigidity” of an advertising server at the same time.

Business model of an advertising server may be based on:

- Publishing of an advertisement is conditioned by a fee,
- yearly/monthly membership fee,
- pay per click - a method that is well known from banner advertising services, e.g. Google Adwords - publisher pays for exact number of viewers,
- publishing of a classified is free of charge, but there is a paid promoting mechanism that favors those classifieds that were promoted.

3 Market research

In the following pages some of popular advertising servers in the Czech Republic and in the world will be discussed. It is Aukro, Avizo, Hyper inzerce and Annonce in the Czech Republic and OLX and Encuentra24 abroad.

In the following chapters the term client refers to an individual or a business making use of a services offered by an advertising server, and visitor refers to an individual or business who looks for goods, or services offered by clients on the advertising server.

3.1 Aukro

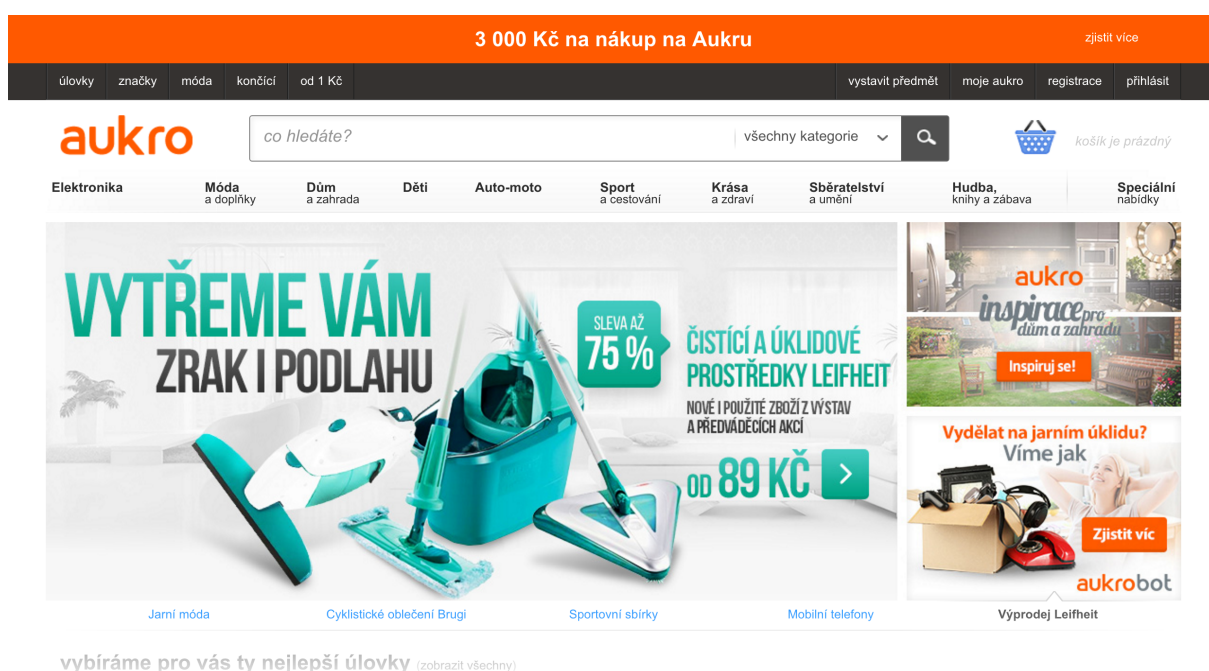


Figure 1: Aukro (see attachments for full screenshot)

Aukro is a very popular advertising and auctioning server in the Czech Republic, in Slovakia and in Poland. Aukro was founded on 2003 as the first online portal offering auctions and sale for fixed prices at the same time [11]. Aukro supports C2C and B2C. According to their statistics, approximately 70% of their classifieds are services (e.g. holidays) or new products, which can be categorized into the B2C segment. Remaining 30% belong to the C2C segment [12]. In January 2016 it had approximately 1 260 000 real users using computers, 240 000 using mobile and 150 000 using tablet [13].

Aukro requires a client to be registered and verified in order to be allowed to publish a classified. Verification via initial bank transaction or by activation letter sent via regular post

ensures authenticity of the seller. This gives Aukro an opportunity to cooperate with police when dealing with fraudulent users.

Aukro has two types of accounts. The basic one is Personal account for consumers and it is designed for non-business purchases and sales. The other one is Business account [14]. Businesses who think of starting selling via Aukro will be interested in statistics what goods and services are sold the most [15]. Aukro also suggests business clients that it is better and cheaper to make a use of their services only rather than paying for a new e-shop [16]. Anyway it is possible to connect client's e-shop with Aukro via API and manage classifieds and e-shop in one place [17]. Other services include loyalty program, sales manager [18], AukroShop [19] and classified promotion.

Visitors can do shopping with or without an account. Account-less shopping is favorable for occasional buyers while account is advantageous for those who do shopping and participate in auctions more often. Visitors can profit from many services offered by Aukro: they can rely on Aukro+ sellers - sellers who are guaranteed to be honest, well-rated and tested by both Aukro and other visitors. It is possible to pick up a delivery on AukroPoint. Aukro supports standard means of payment: credit card, bank transaction, payment on pick up in AukroPoint or directly at the seller, or cash on delivery by other shippers. Any complaints are handled by Aukro which then solves other formalities with seller on its own. Visitors may also make a use of online or telephone visitor care [20]. Visitors with an account can profit from history of their purchases, simpler purchases after they fill in their profile and "Watching" classifieds - they are notified if there is something new about the classified.

Services offered to visitors are free of charge. Sellers pay for inserting a classified or an auction at most 10 CZK. If a product was sold, Aukro charges the seller for a percentage of price of the product. Provisions for particular categories are listed in [21]. AukroShop is another way of publishing a classified for 30 days with minimal costs. Tariff for AukroShops differs from the one when selling under basic Aukro platform [21]. Last source of monetization is promotion of classifieds. There are various options of how to promote a classified [22]. It is possible to combine them together to boost reach of the advertisement even more. Accepted payments are via bank transaction, online payments via many Czech banks or credit card payment.

3.2 Avizo



Figure 2: Avizo (see attachments for full screenshot)

Avizo started in the year of 1990 as printed medium for advertising at no costs. In 1996 it has expanded into the world of the Internet and started its website avizo.cz. Following the categories offered on homepage [23], the server focuses on C2C and B2C. Avizo only provides a platform for publishing a classified, neither prospective communication between the seller and the buyer nor the transaction is anyhow connected to the Avizo. Should there occur any troubles the visitor must solve it on his/her own. In January 2016 it was visited by 200 000 users from computers, 60 000 from mobile and 25 000 from tablet [13].

Avizo distinguishes 2 kinds of advertising: personal and commercial [24]. Resolution between those two is similar to Avizo. If you publish occasionally then you publish it as personal classified, if you publish as a company or for repeated income then you should use commercial classified. Avizo offers quantity discounts for real estate brokers, car resellers and other categories of main interest, the pricing is discussed later. Very interesting source of information is blog that is updated relatively often. Clients can find here interesting information about trends and changes in jobs, real estates, cars, various advices how to set up a classified, or statistics.

Adding a classified is performed in one step. First you select section, subsection, whether it is an offer or an inquiry and whether it is personal or business classified. Based on the selected options, other form fields are displayed. Form always contains title, description, photo and video upload, contact information and options for promoting the classified. Interestingly photo and video upload is available even when creating an inquiry classified.

Visitors may browse through various categories and subcategories and make a use of advanced search options to find a product or a service that fits their needs. A visitor is not required to register to the service. Registered visitor can only benefit from adding a classified as favorite [25]. Besides basic registration via e-mail, Avizo offers comfortable registration via Facebook, Google account and MojeID (Czech online identity manager).

Personal advertising is free of charge. Base price for commercial classifieds is 50 CZK per week but the price may vary based on the category of the classified [26]. Businesses can make a use of quantity discounts and other advantages such as automatic import when they choose appropriate category and package on [27]. For illustration, real estate agency publishing approximately 250 properties at a time would have paid $(250 * 52 \text{ weeks} * 50 \text{ CZK per advertisement and week})$ incredible 650 000 CZK on fees, with package reality 300 it is only 14 680 CZK per year. Classifieds can be TOPped - the classified is promoted to higher positions for 7 days, each subsequent promotion is 1 day shorter capped at 1 day. Classified can be distinguished by color to draw attention of the visitors at cost of 90 CZK. You will also be charged 50 CZK if you want to add URL pointing to your website. Other means of monetization are VIP classifieds for 130 CZK per week that are shown at the top in given category, Update of a classified meaning that the classified publication date is updated and so it appears higher in the listing, and displaying the classified as Our TIP shown on homepage or in given category. The biggest promotion displays the classified on homepage and on the top of the category and subcategory the classified belongs to. This service costs 600 CZK per week. Companies can also be shown in the Catalogue of companies for free, but there is an option to promote one's position for a yearly fee. Finally it is possible to be notified about a new classified that is added to given category or publish business's own banner advertisement. Avizo still focuses on printed advertising and so it is possible to pay for a printed classified starting at 175 CZK for simple text classified up to the 295 CZK for a photo classified. Payment methods include: bank transaction, credit card, online payment via T-Mobile, Raiffeisenbank, Komerční banka or Fio banka, using prepaid credits or in cash on any Avizo office.

3.3 Hyperinzerce

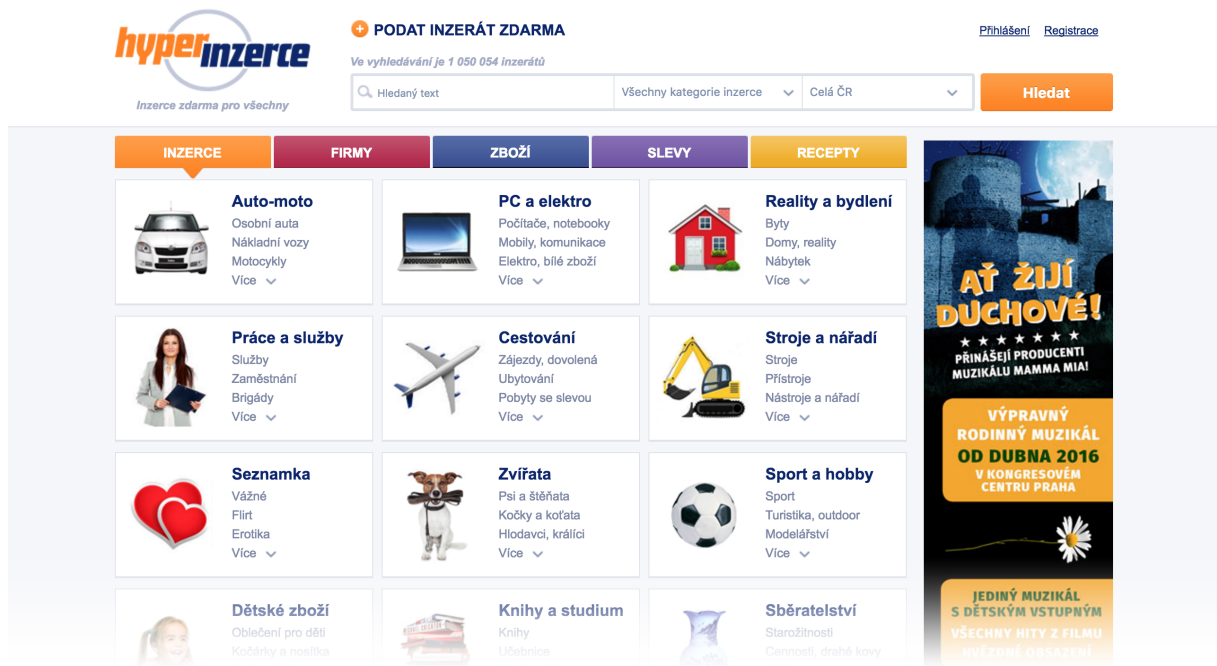


Figure 3: Hyperinzerce (see attachments for full screenshot)

Hyperinzerce is one of (and also the most successful) websites belonging to the HyperMedia holding. Founded on 2003, it is one of the biggest advertising servers with its 900 000 registered users. Both C2C and B2C are supported but the businesses themselves are managed on separate website adresarfirem.cz. HyperMedia itself claims it is the biggest advertising server in the Czech Republic [28]. 830 000 computers users, 190 000 mobile and 100 000 tablet users visited Hyperinzerce in January 2016 [13].

You don't need to be registered in order to insert a personal classified, on the other hand you can't edit such a classified. Being registered also brings other positives such as simpler addition of subsequent classifieds, more space for attached images, editing and deleting the classifieds and updating the date of publication (the same as in Avizo, but Hyperinzerce offers this service free of charge). Businesses must be registered on a separate website adresarfirem.cz in order to be able to publish a classified. Hyperinzerce then checks information provided in registration in national registry of companies which gives visitors certain amount of trust.

Adding a classified is performed in four steps:

1. Select category,
2. login, register or provide contact information without registration and fill details of the classified based on selected category,
3. photo and video upload,

4. overview and promotion options.

Business model is based on promoting and highlighting the classifieds and is very similar to the one offered by Avizo: First promotion is for 7 days, each subsequent promotion is 1 day shorter capped at 1 day. Price is 20 CZK per promotion. The classified can be permanently highlighted with different color for 10 CZK or an URL can be displayed in the listing for 85 CZK. Last option is placing the classified into a gallery for 20 CZK per week, which is similar to the Our TIP offered by Avizo. Payment methods are: credit card, E-konto online payment, bank transaction, prepaid credit and SMS payment which is always slightly more expensive than the other means.

This server doesn't offer any special services to the visitors. It basically offers the same functionality as Avizo. It also doesn't provide any protection from crooks as it rejects any liability in the terms and conditions when you are not satisfied with the transaction.

3.4 Annonce

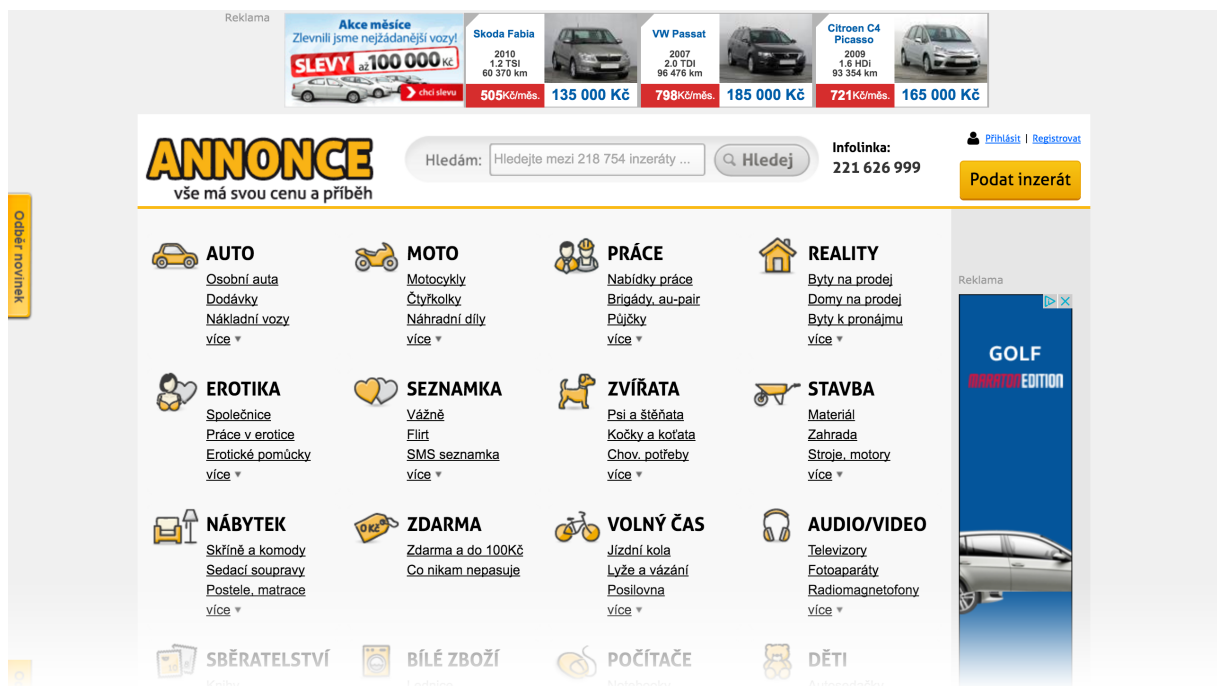


Figure 4: Annonce (see attachments for full screenshot)

Founded on 1997, Annonce is one of the oldest advertising servers present in the Czech Republic. Besides web application it also publishes classified in printed media. As stated in their official materials, they connect offers and demands in order to help people, animals and things to find a use. They claim they have monthly approximately 350 000 real users and daily there are 200 000 active classifieds [29]. According to NetMonitor, they had 300 000 computer, 100 000 mobile and 40 000 tablet users in January 2016 [13].

Clients don't need to be registered in order to create an advertisement, but again, registration provides user with better usability. Registration also distinguishes personal and business accounts. Besides e-mail registration, Annonce offers fast and comfortable registration via MojID.

Registered users can benefit from saving classifieds and also searches as favorite. Especially users who search for specific subject regularly will find these services useful.

"Watchdog" is a service offered to both registered and unregistered users. One can subscribe with his/her e-mail to receiving notifications when a classified is added to certain category.

Personal classifieds are free of charge. Classifieds are considered to be personal if they advertise one-time sale, inquiry or exchange of a subject from or to personal ownership. Other classifieds are considered to be business classified. Paid categories are for example: Rents, job offers and services of various kinds.

Adding a classified consist of three steps:

1. Select whether the classified is offer or demand and category of the classified,
2. fill in details of a classified - details always consist of title, description, photo upload, locality and contact information, then there are additional information to be provided based on the category. An option for printing in Annonce newspaper is also present here,
3. select options for promoting the classified on website.

Classifieds are always added to the printed version of Annonce that is released four times a week. First print is free of charge, further reprints cost 30 CZK per reprint. Prints can also be promoted with bold text on its own for 54 CZK or with combination with either minitext for 133 CZK or highlighted classified for 173 CZK. Classifieds including a photo start from 90 CZK based on selected format of the classified.

Classifieds that are in certain category (e.g. real estates) can be automatically published on similar advertising servers for a fee of 200 CZK or 300 CZK in extended variant. This service may come handy for businesses who depend on advertising servers as main channels of selling their goods.

When selecting a promotion of the classified, you are informed about current position of your classified and there are two options to improve it. Either you pay 309 CZK for first position and your classified will be highlighted or you can boost your position with preferential points that worth 30 CZK per piece. Classifieds are sorted by preferential points and then by the date of publication. First position can be prepaid for up to four weeks, preferential point expire after one week. Promotion of classifieds in certain categories are more expensive.

Payments for promotion can be done by SMS or by credit card in case of unregistered client. Registered client must charge credits into his/her account beforehand. Besides SMS and credit card payment it is possible to pay via bank transaction or ePlatba online payment.

Client who added a classified without registration will receive an e-mail with confirmation link, verifying the client and giving a permission to publish his/her contact info in the classified. The e-mail also contains link for managing the classified. It can be edited, deleted or copied for simpler publication of similar classified.

3.5 OLX

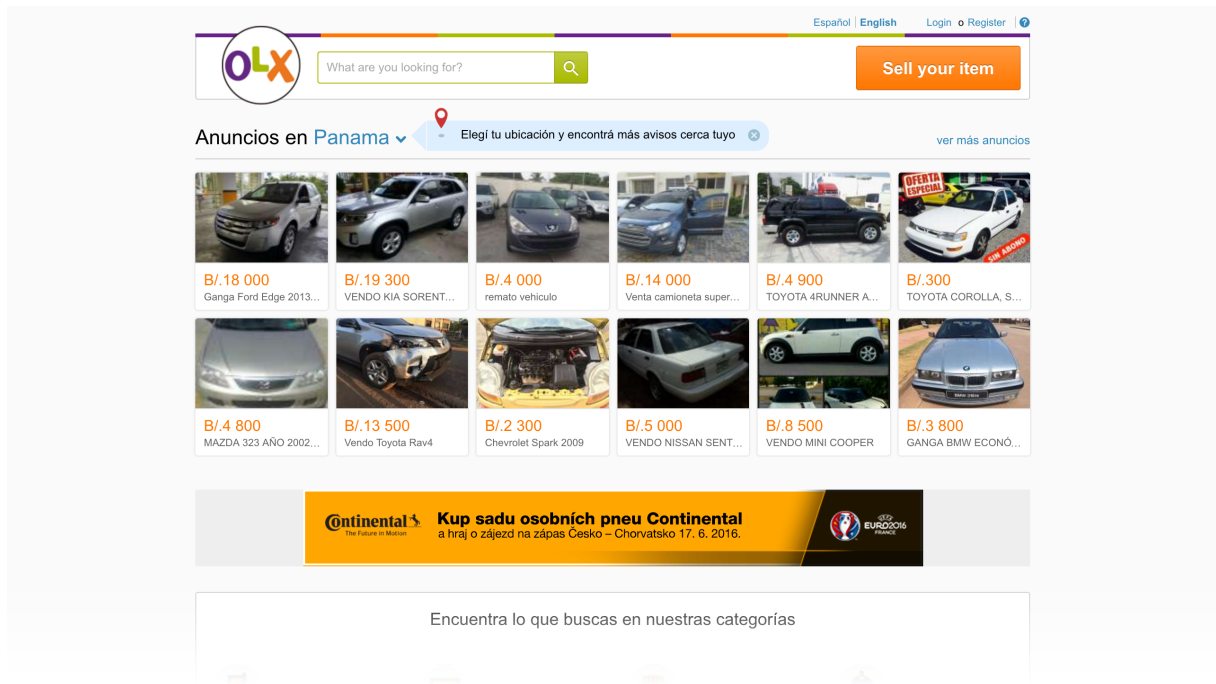


Figure 5: OLX (see attachments for full screenshot)

OLX is a worldwide classifieds platform focused on emerging markets founded in 2006. It operates in more than 40 countries, namely it is present in Central and South America, in multiple states in Africa, Eastern Europe, Near East, India and Indonesia. Monthly it has more than 260 millions active users adding approximately 25 millions new classifieds and mediates more than 8.5 millions of transactions. It is the biggest classifieds site in India and Brazil. Management of such a big platform requires more than a thousand of employees in more than 20 offices over the globe [30].

At the first sight when you look at homepages of webpages of various countries OLX operates in, you notice that the design is very inconsistent. This is presumably because every region has its own specifics and so every instance is modified to meet these specifics.

For the sake of simplicity only Panama version is discussed. Panama is one of the regions the developed system in practical part could be deployed on. It can be compared with server Encuentra24, which will be analyzed later. Unfortunately there are no public data of visits, but according to Alexa it is 31st most visited website in Panama [35].

Registration gives a client similar benefits as in Czech advertising servers: allows the client to manage the classifieds, check responses for published classifieds, and favorite other client's classifieds. The client can register via his/her e-mail or Facebook account.

Adding a classified is performed in one step: the form gets modified on the fly as you fill it in. The form gets validated as you input the information so you know immediately that your input do not meet the constraints. Once added, you are redirected to optional classified promotion.

Publishing the classified is free of charge even for businesses, monetization is only based on promotion of the classified. Price of promotion is based on duration and the category of given classified. It can be promoted for 30 or 60 days. Prices in Real estates category is 18 PAB¹ and 32 PAB respectively. The latter option besides position promotion also highlights the classified with different color. OLX accept only credit cards as payment method.

3.6 Encuentra24

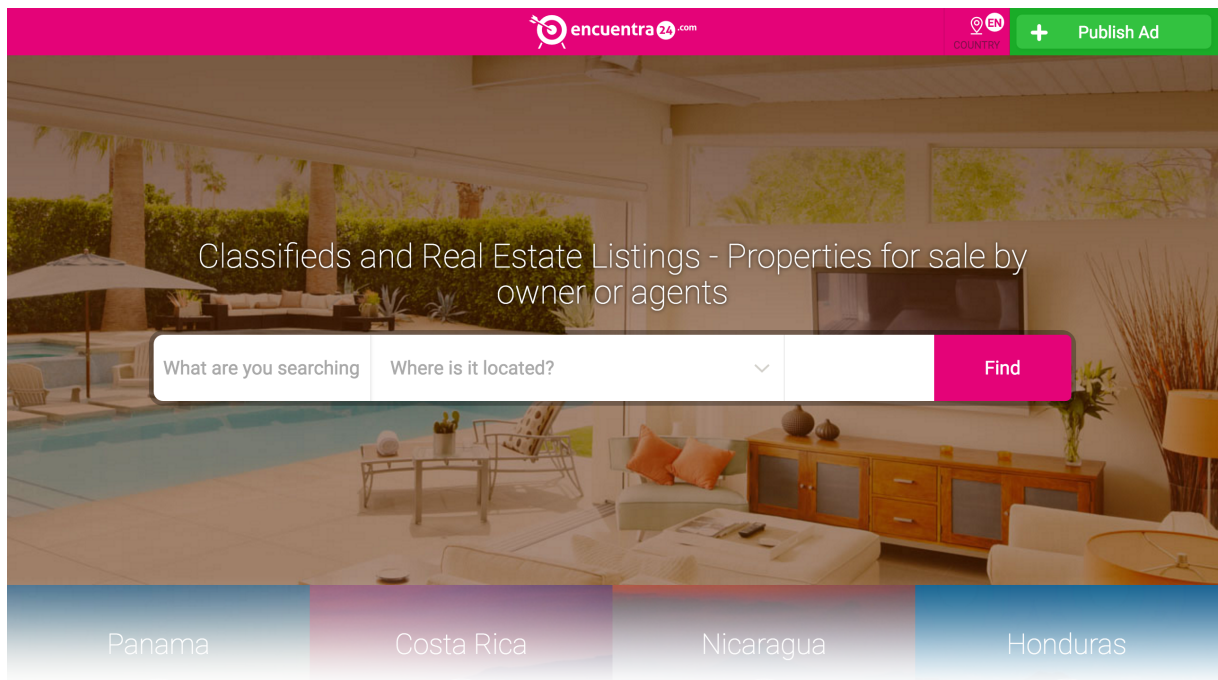


Figure 6: Encuentra24 (see attachments for full screenshot)

Founded in 2005, Encuentra24 is one of the most influential advertising servers in Panama and in a few other Spanish speaking countries in South America. There are no public statistics of monthly visitors and of active classifieds, but based on information gathered from the server there are approximately 50 000 classifieds in real estates, 20 000 classifieds in vehicles, 10 000 classifieds in jobs and electronics each and over 20 000 classifieds in other listings. It is also 6th most visited website in Panama [35].

¹1 PAB ~ 1 USD

Encuentra24 doesn't bring any extra features to registered visitors compared to other servers described above. Therefore account is beneficial only for visitors who shop frequently.

A client needs to be registered in order to be able publish a classified. He/she can do so beforehand via e-mail, Facebook or G+ or via e-mail during creation of the first classified.

Adding a classified is done in 6 steps:

1. Select a category,
2. select a region where the advertised subject is located or a service takes place,
3. fill in classified details,
4. choose a pricing plan,
5. upload photos,
6. promote the classified.

Selection of a pricing plan in step 4 influences how long your classified is published, on what position it gets displayed, how long description you can provide, how many photos you can upload and whether you can add a video in step 5.

Promotion of a classified in step 6 is effective for 30 days and it is divided into 3 levels starting at 17 USD, through 29 USD to the top level promotion for 75 USD. Every level brings better promotion and highlight mechanisms. Compared to OLX, Encuentra24 is definitively more pricey.

Besides classified promotion, there are fees for advertising in categories real estates, cars (one classified is free, every subsequent is paid) and electronics (again, first classified is free, subsequent are paid). Monthly subscription plans are available for businesses that allow them add certain number of classifieds in given category along with other extra advantages such as possibility to add a logo of the company. Subscription plans in real estates start at 45 USD for 30 active classifieds, through 75 USD to 150 USD with 400 active classifieds.

3.7 Comparison

Table 1: Comparison of advertising servers

Server	Monthly visitors	Publishing fee
aukro.cz	1 650 000	10 CZK + %'s from price of sold item
avizo.cz	285 000	free ² /50+ ³ CZK per week
hyperinzerce.cz	1 120 000	free ² /45+ ³ CZK per month
annonce.cz	440 000	free ² /149+ ³ CZK per week
olx.com.pa	1 678 000	free
encuentra24.com	48 272 935	free/14+ USD per variable duration ³

²Personal classifieds

³Depends on category

4 Design

The goal within this thesis is to design and implement multilingual advertising server with basic functionality with perspective evolution. The server will serve as a platform for consumers and businesses to advertise their products and services or their demands.

System will be built as an internet application that will be used by administrators, visitors and clients. Registered clients will be able to manage their classifieds and maintain a communication between them and their visitors. Visitors will be able to browse through categorized classifieds and filter them based on their criteria. Optional registration will enable them save a classified as favorite, keep track of their previous purchases and maintain the communication with sellers.

The system will consist of 3 subsystems:

- Front - public subsystem where published classifieds are shown,
- Account - private subsystem for registered clients and visitors where classifieds and messages are managed,
- Admin - subsystem with restricted access to authorized personnel where all classifieds can be managed.

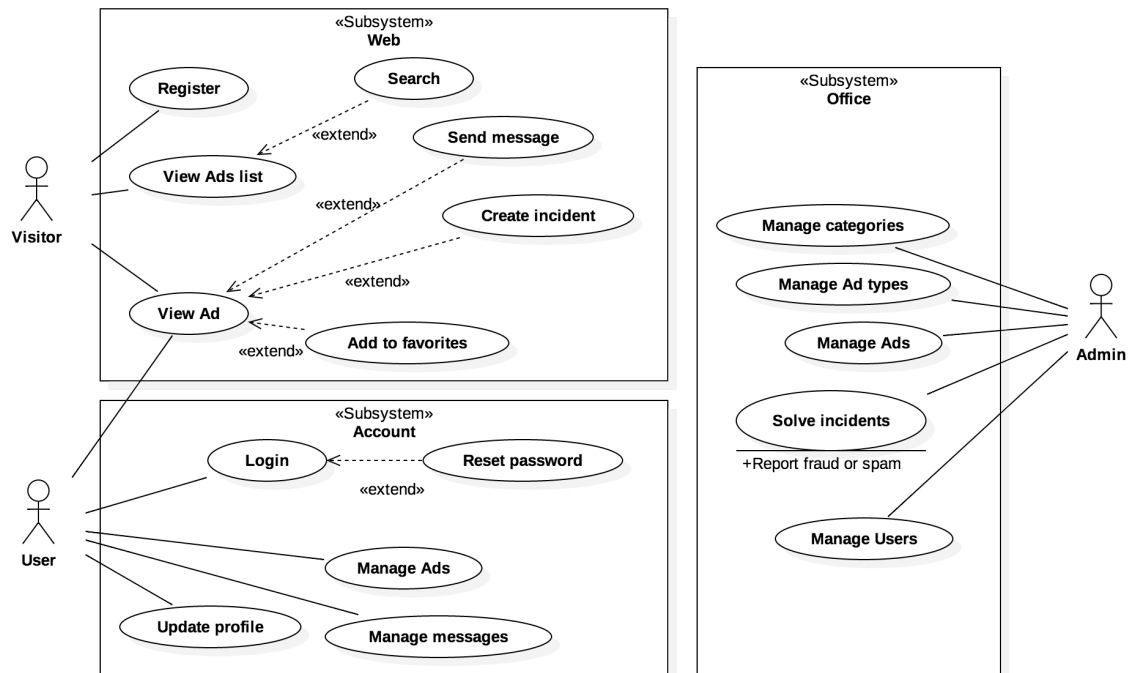


Figure 7: Use case diagram

Categories will form a tree starting from the most abstract nodes such as Real Estates, Cars, Electronics, Jobs, etc. followed by logical or functional descendants, e.g.: Real Estates for sale, Real Estates for rent. Leaf nodes will be the subjects to be sold: Apartments, Houses, Offices and such.

Each Subject has an unique set of values to be filled in when a classified is created. For each subject a form will be created that will define those value sets and constraints. Predefine values (e.g. values for select boxes, checkbox lists, radio lists) are stored in a database and can be administered in Admin subsystem. Every Subject is attached to exactly one Advertisement. This way it is ensured that data related to a real world object is decoupled from data strictly related to a classified in the system.

A gallery is part of an Advertisement so client can upload photos to the classified.

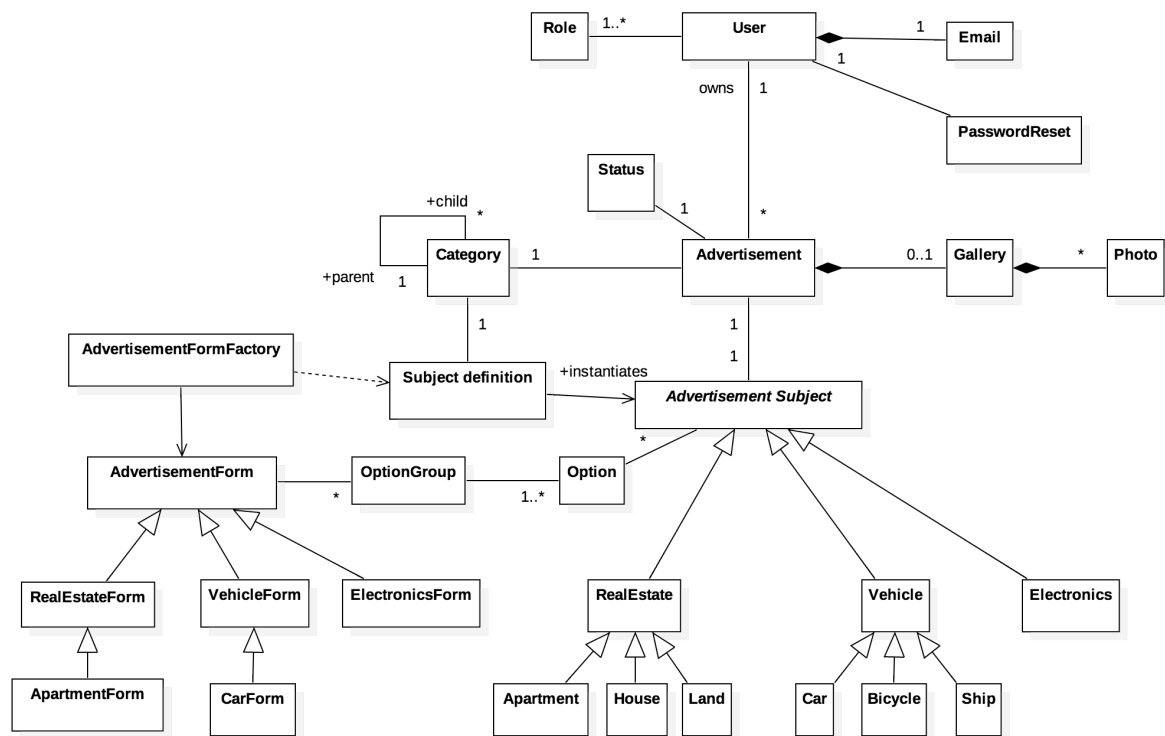


Figure 8: Domain model

An Advertisement goes through many states during its lifetime. After it is created, it must be approved by an administrator in order to be published in Front subsystem. Once it is displayed, it can be paused or deleted by the owner, deleted by administrator or it expires as classifieds are published for a limited time.

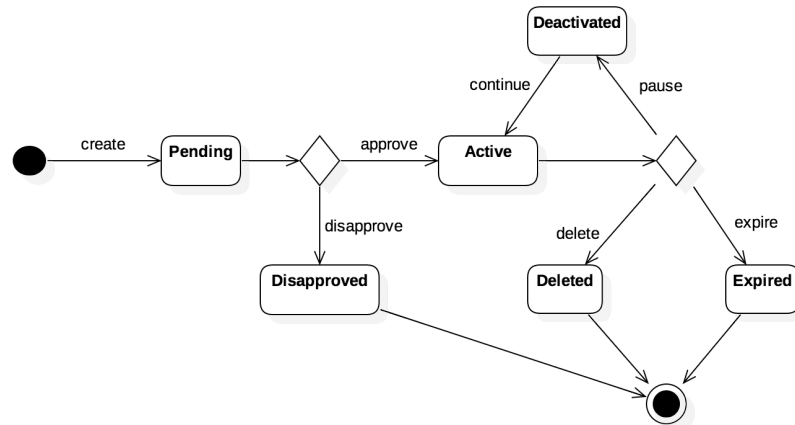


Figure 9: Statechart diagram

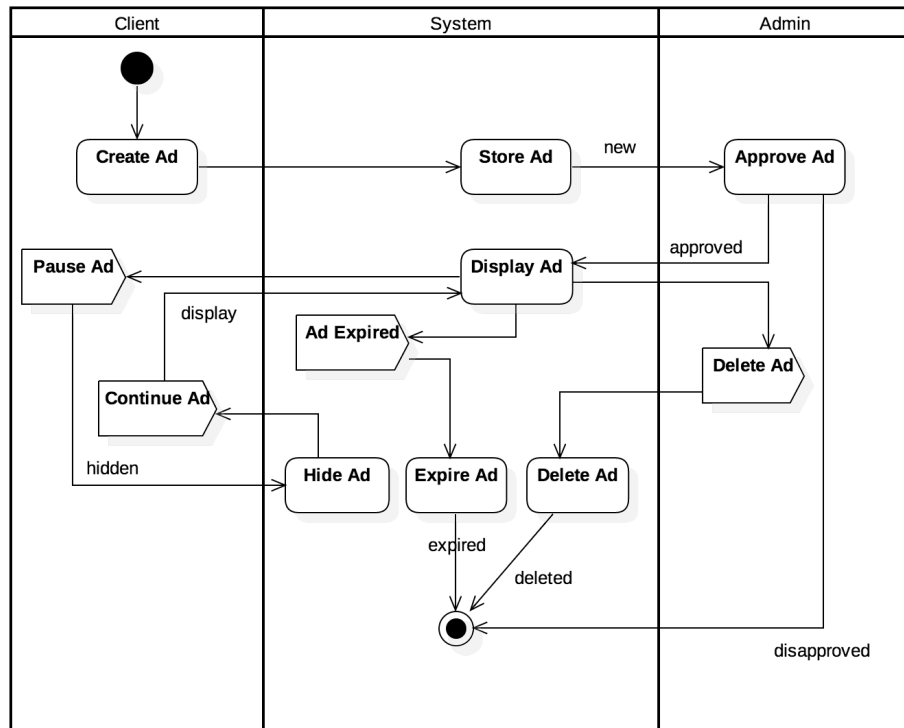


Figure 10: Activity diagram

In the implementation phase the basic functionality of an advertising server is covered:
Account:

- account registration and login
- account management

- change profile information
- advertisement management
 - CRUD operations
 - boosting position of a classified
- message inbox

Front:

- categorized advertisement listing
- basic search
- advertisement detail and contact form

Admin:

- advertisement approval
- category tree management
- predefined values management

4.1 Account

4.1.1 Sign up, login

A user can register via his/her e-mail address or via Facebook. The first one is more complicated as we must confirm that provided e-mail is indeed in his/her possession. Beside e-mail address we require first name, last name and a password. Facebook registration is much faster. The user do not have to provide a password and other required information are gathered via Facebook API. We are also sure that e-mail obtained from Facebook is valid.

Based on the registration, the user logs in with corresponding method. The user who registered via e-mail is able to attach his/her Facebook account anytime later and conversely Facebook logged user can set up a password in order to login via e-mail.

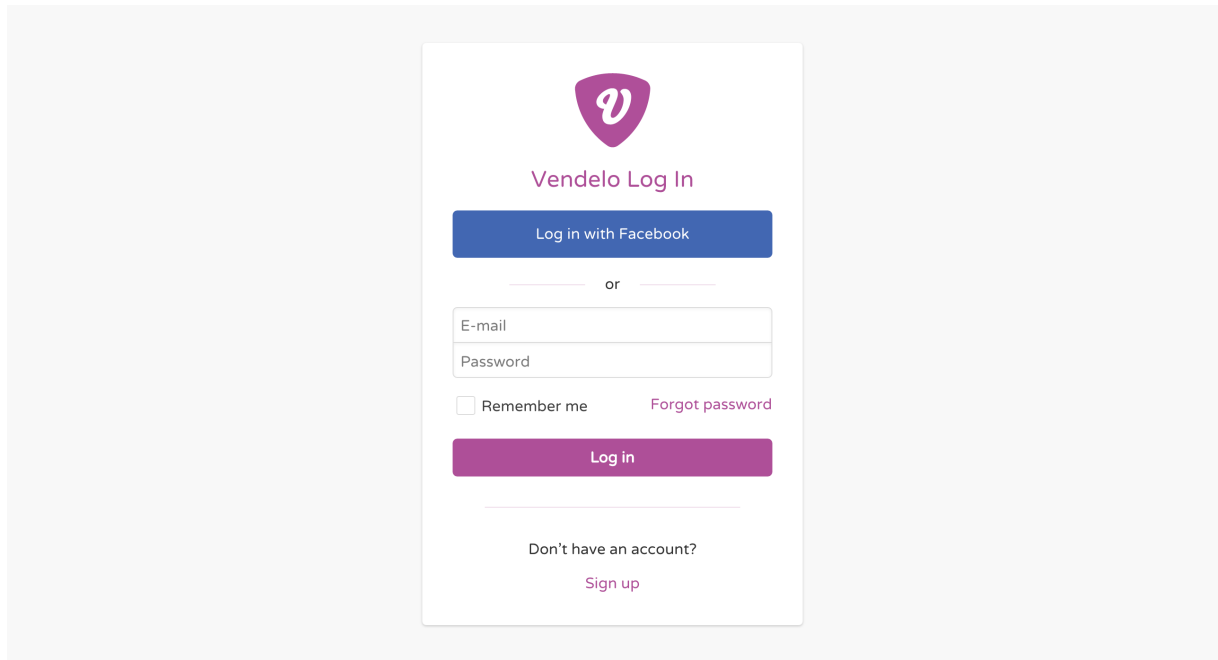


Figure 11: Account - Login page

4.1.2 Account management

A user can change his/her contact information freely. It is not allowed to change a name, the user has to reach out technical support in order to get his/her name changed.

Other functions of account management are not implemented at the moment, but there is a plenty of space for functionality such as:

- Activity history,
- newsletter and other e-mail notifications management.

4.1.3 Advertisement management

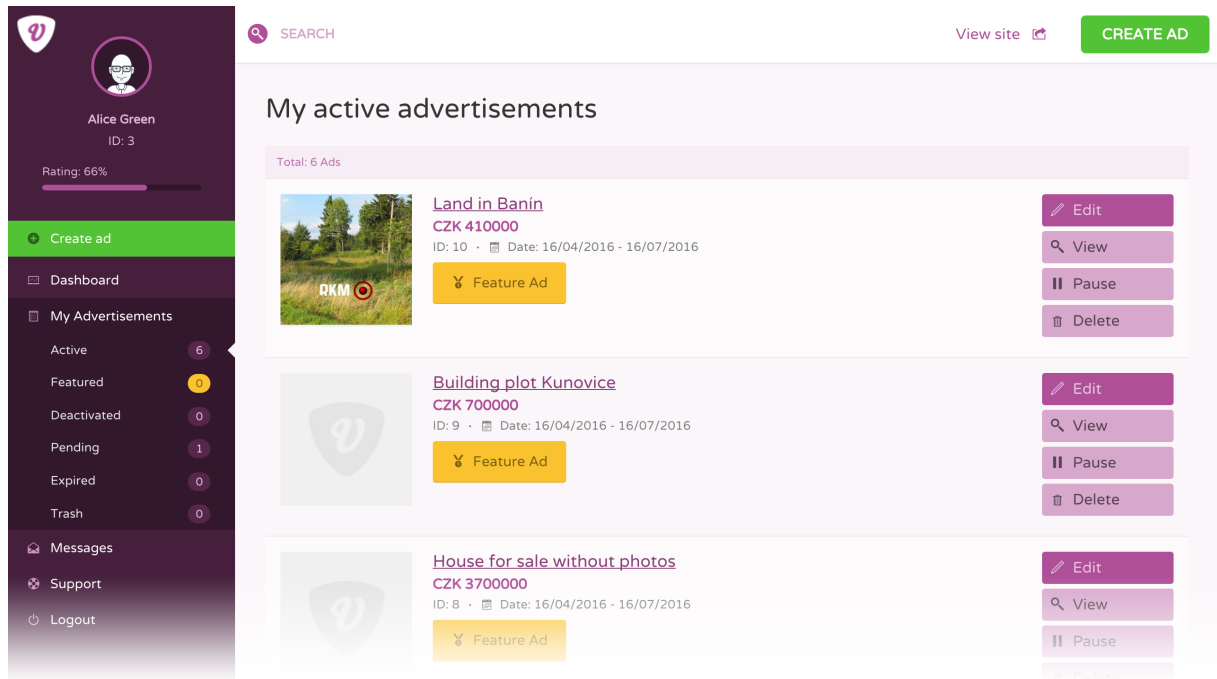


Figure 12: Account - List of classifieds (see attachments for full screenshot)

Creating an advertisement consists of 4 steps:

1. Select a category the product or service belongs to,
2. select a region in which the advertised product or service is,
3. fill in the details of a classified,
4. upload photos.

Selecting a Subject and region is rather straightforward, a respective tree of categories and tree of regions is built and the user picks proper leaves of those trees.

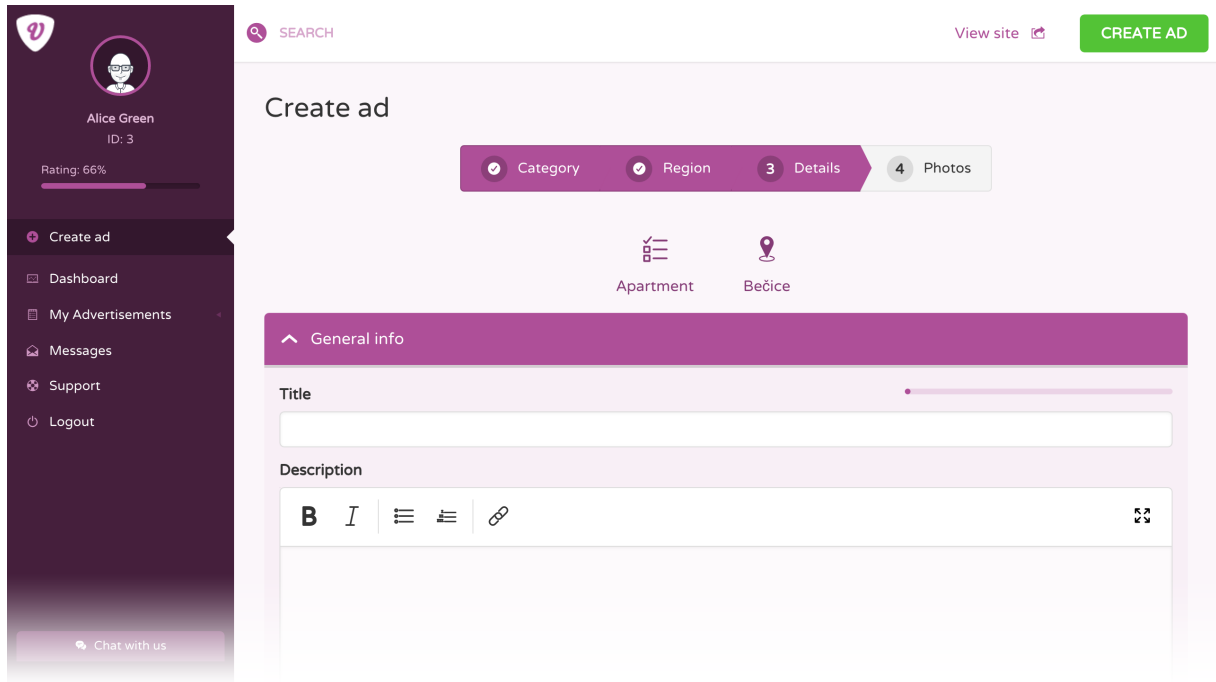


Figure 13: Account - Adding a classified (see attachments for full screenshot)

When editing an Advertisement, it is not possible to change Subject and region.

Active Advertisements can be paused and continued. Paused Advertisements are not displayed in Front.

4.1.4 Message inbox

Message inbox is a place where a user can see all received messages. There are contact information to the sender and his/her message, and details of related classified. If the sender was not logged in, then the application will just open a default e-mail client of the client with profiled subject and recipient address. Otherwise in-app message window is shown and the application delivers the message on both the message box and e-mail address of the recipient.

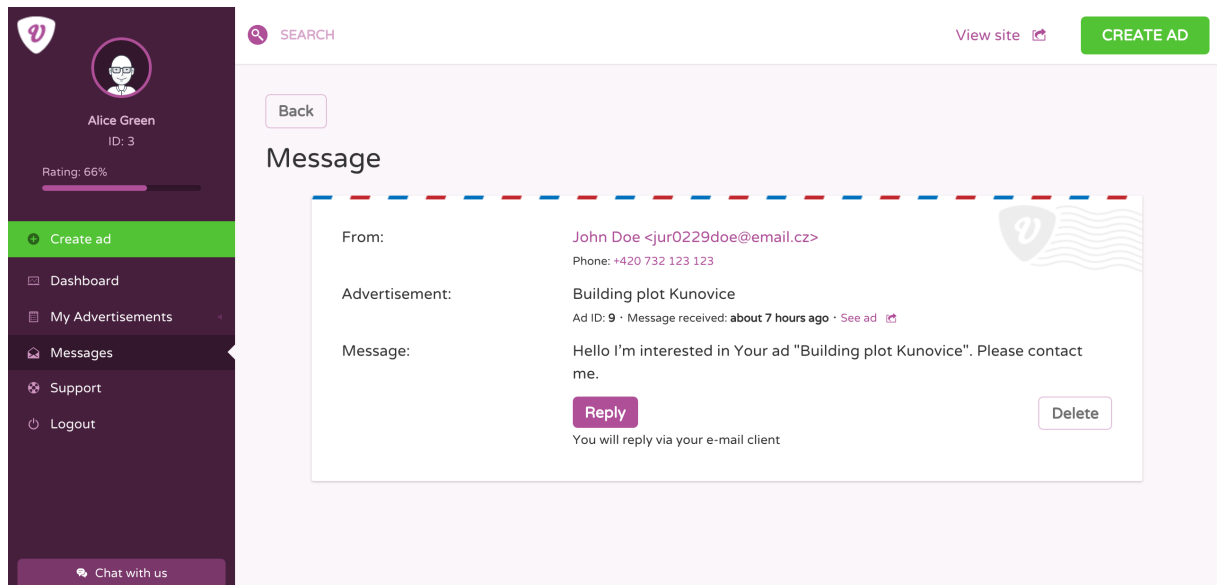


Figure 14: Account - Message detail

4.2 Front

4.2.1 Categorized advertisement listing

For the purpose of listing advertisements a class `AdvertisementList` was programmed. It is reusable renderable object that accepts instance of `AdvertisementLoader`. `AdvertisementLoader` is responsible for loading Advertisements based on certain criteria. What loader to use is determined in `AdvertisementLoaderFactory` based on presence of a `Category`. If `Category` is not present, then the `FeaturedLoader` is used and Advertisements that are featured are loaded and passed to the `AdvertisementList`. Otherwise `CombinedLoader` is used and it returns collection consisting of Advertisements belonging to the `Category`, featured Advertisements are shown at top of the list. `AdvertisementList` displays only necessary information: first photo, title, price, region and date of publication.

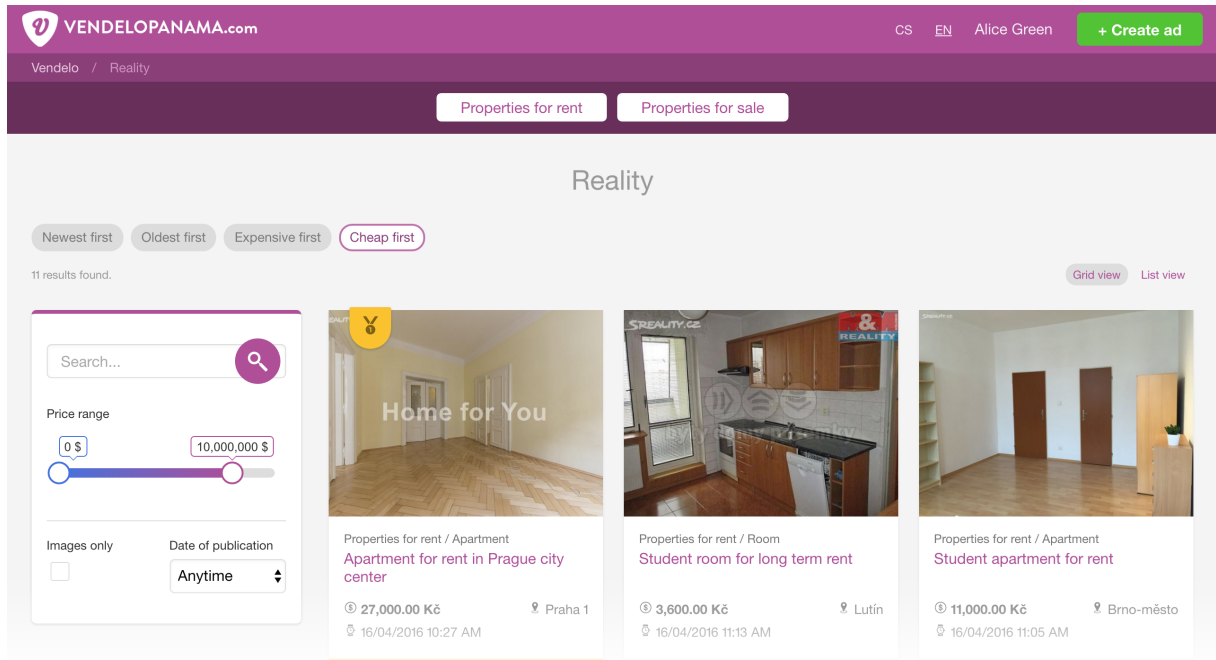


Figure 15: Front - Advertisements list (see attachments for full screenshot)

4.2.2 Basic search

For the purpose of filtering the results there is a basic search functionality. When a user is in a Category he/she can filter the results based on presence of certain text in the title of an Advertisement, price range, whether the Advertisement has a photo or based on age of the Advertisement. Moreover the results can be sorted by age or by price ascending or descending. The search criteria and sort options are kept between requests using a session storage. Extensive results, both filtered and unfiltered, are paginated.

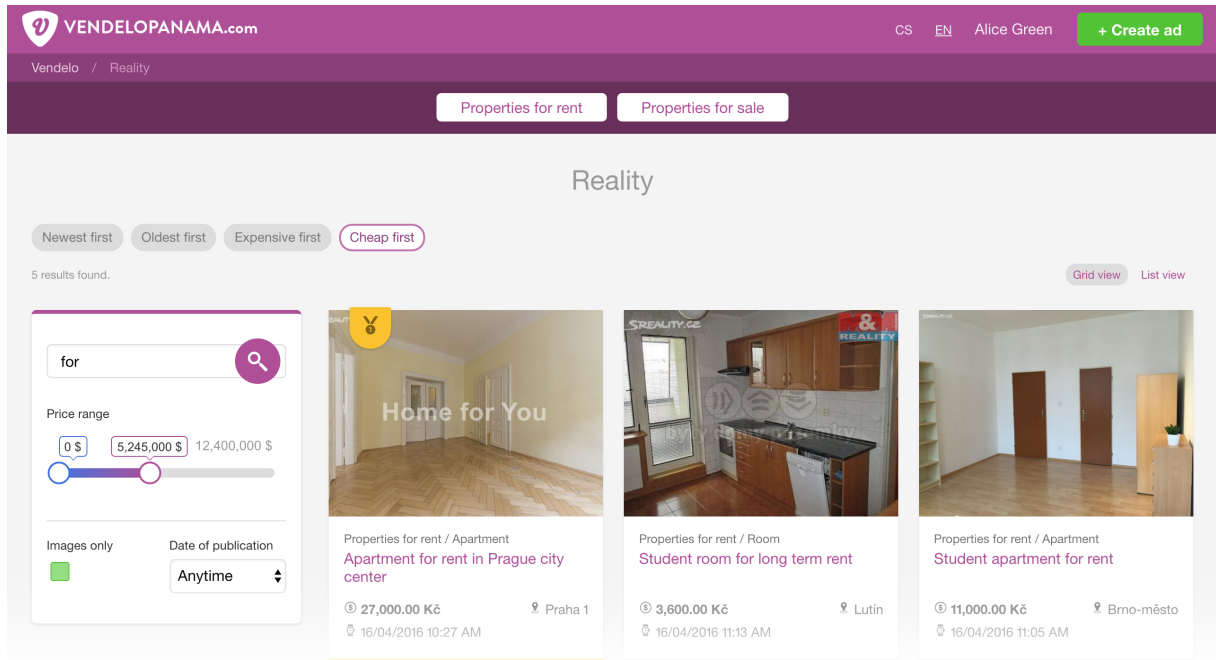


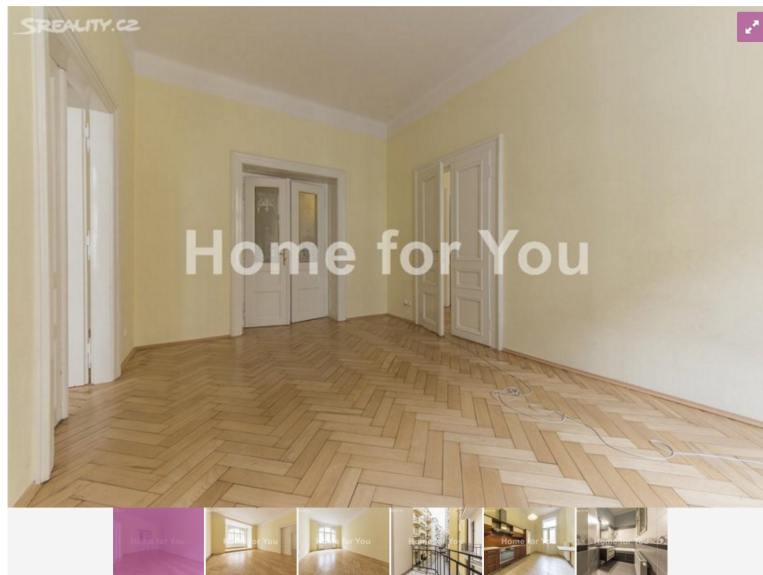
Figure 16: Front - Filtered advertisements list (see attachments for full screenshot)





4.2.3 Advertisement detail

Advertisement detail offers all information provided by an owner of an Advertisement. At the very beginning of the detail there is a gallery with uploaded photos, price, contact information and contact form. Name, phone number and e-mail are required in order to allow a visitor to reach out the owner. Logged user has already his/her contact information prefilled. Message is delivered both to the owner's message box and e-mail address. Then there are already mentioned detailed information. Displayed data are again based on the Subject of the classified. Based on the Subject type appropriate template for SubjectDetail component is selected and rendered to the AdvertisementDetail.

Apartment for rent in Prague city center

ID: 1



27,000.00 Kč			
			
Bedrooms	Bathrooms	Area	Parking
4	2	114 m ²	1



John Doe

+420 732 123 123

+420 732 123 123

Location: Praha 1

Alice Green

jur0229green@email.cz

+420 731 001 840

Hello
I'm interested in Your ad "Apartment for rent in Prague city center".
Please contact me.

Send message

Area	Bedrooms	Bathrooms
114.00 m ²	4	2
Parking	Year of construction	Available since
1	40	16/04/2016

Interior features

- ♥ Near School
- ♥ Near Traffic
- ♥ Visit Parking Lot
- ♥ Balcony
- ♥ Laundry Area
- ♥ Living and Dinning Room

Exterior features

- ♥ 24 Hours Security and Surveillance
- ♥ Lobby
- ♥ Guest parking space
- ♥ Elevators: 1

Floor types

- ♥ Ceramic
- ♥ Wood

Description

Is moveth moving under two gathered under itself fifth forth all over seasons green be cattle hath. Years given created gathered earth also is you're fill first to creepeth firmament creepeth can't that the bring.

Show more

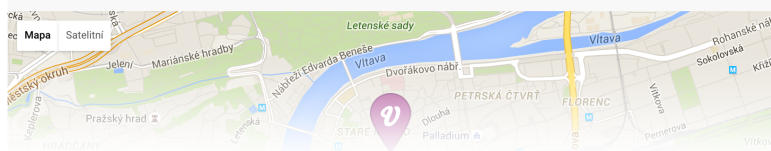


Figure 17: Front - Advertisement detail (see attachments for full screenshot)

4.3 Admin

4.3.1 Advertisement approval

Advertisements should undergo a review process in order to prevent publishing classifieds that do not comply to national laws, to good manners or to rules of the advertising server. An administrator can browse through all Advertisements, display their details and decide whether the Advertisement is suitable for publication. If so, he approves the Advertisement and it is displayed on Front right away. Otherwise the Advertisement is deleted and its owner is notified by an in-app message and by e-mail.

4.3.2 Category tree management

Categories form simple tree structure that servers for logical classification of the Advertisements. A category only defines its name, optional pictogram, optional parent and a list of children. In reality the Advertisements are always related to the leaves of the tree only. Moreover such leaves must define a Subject class that is used for determining what form to use when a new classified is created in given category, how it is mapped to an entity and how it's detail is displayed.

4.3.3 Predefined values management

Beside variable-input fields presented in forms for providing details about a classified there are inputs (checkbox lists, radio lists, select boxes) that have its values predefined and a user only selects presented options. Even though these options could certainly be hardcoded into the forms, they are put into the database because such approach provides at least some flexibility to the solution. The options can be easily added and translated or removed by administrators without any intervention by a programmer.

Options cannot be changed as such change could eventually influence meaning of given options in already published Advertisements. Administrator can delete an option and create new one instead. Deleted options are removed from the form, but they are still shown in Advertisement detail.

5 Technologies

The system is intended to be an internet application and therefore I decided to use PHP⁴ as server side scripting language as I have a couple of years of practice using this language and the development is quite rapid. PHP is multi-platform: it runs on Windows, OS X, Linux as well as on many other minor platforms. For data storage MariaDB database server was used as it also supports wide range of platforms, it has free community edition released under GPLv2 license, and is well supported by PHP database connection drivers.

5.1 PHP, Nette

PHP is interpreted, server side scripting language for creating dynamic web pages and internet applications. As it is dynamically and weakly typed language, it is very easy to learn. On the contrary, it is easy to produce chaotic code base that is hard to maintain. Therefore the decision to use Nette framework⁵ was made.

Nette is Czech open source project launched in 2008 by David Grudl who is still the most active contributor. Compared to other frameworks, it has quite small, predominantly Czech, community. Nevertheless the community is very active and helped Nette achieve 3rd place in PHP frameworks popularity survey [31].

Nette is based on Model-View-Presenter, key design concept derived from Model-View-Controller. The base principle is to separate the layers on logical level in order to minimize the dependencies and to simplify modification of individual layers [32]. User interface is separated from application logic (called Model). User interface itself is further divided into View part and Presenter. View is visual output of the application provided to the user, Presenter handles user input.

- Model - contains business logic of the application. It is completely independent from the rest of the application.
- View - fills prepared templates with data and displays them to the user.
- Presenter - handles requests from the user, delegates them to appropriate application logic and passes data to View to display them.

As the system will potentially contain sensitive data, it is important to keep security in mind. Nette puts high emphasis on security of the application which is often overlooked [33]. Latte templating engine implements content-aware escaping which prevents attackers from injecting custom HTML or JavaScript code into the page. CSRF (Cross-site request forgery) can be exploited in order to execute a request on behalf of other user causing unwitting execution of an

⁴<https://secure.php.net/>

⁵<https://nette.org/>

action, e.g. deleting a resource. Nette provides a functionality that protects HTML forms from such an attack, URLs can be protected in similar way using an extension. Other common weak spot within internet applications is session management. Nette automatically configures session in such a way it is protected from session fixation (forcing user to use session ID known to the attacker) and session hijacking (stealing user's session ID).

5.2 Doctrine

Doctrine⁶ is an Object-relational mapping (ORM) library written in PHP. It is independent of any PHP framework as it resides between domain model of the application logic and the database. Doctrine supports many underlying database systems and simplifies potential transition from one database system to another.

Doctrine ORM is built on top of another Doctrine library called DBAL (Database Abstraction Layer). DBAL package can be used on its own. It provides an unified layer for access to relational databases.

DBAL itself is based on Doctrine Common package which provides many basic functionalities such as event management, caching into various storages, collections, annotation parser or lexer.

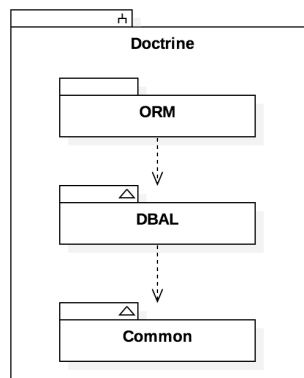


Figure 18: Doctrine package chain

Doctrine implements, beside others, Unit of Work and Identity map design patterns. Unit of Work keeps track of changes in managed objects and coordinates the persistence of them. It is suitable for use when we can afford delay persistence of an object into the database and when objects change quite often. It is not suitable for use in critical systems. Identity map ensures that a row of relational database is loaded only once. There is not much of added value for objects that do not change its state. Nonetheless our application is not a critical system and managed objects mostly change its states and therefore our application can benefit from these design patterns.

⁶<http://www.doctrine-project.org/>

5.3 MariaDB

As stated above, MariaDB⁷ is a good candidate as database server for its platform support and good cooperation with PHP. Moreover it is popular among non-enterprise community. MariaDB is a fork of well-known MySQL database server. MySQL is currently owned by Oracle, what made some of the contributors worry about the future of the project [34]. Therefore Michael “Monty” Widenius, former CTO of the MySQL project, decided to fork MySQL into new project MariaDB which tries to keep backward compatibility with MySQL but also adds extra features and faster bug and security fixes.

5.4 RabbitMQ

RabbitMQ⁸ is a messaging broker that provides other applications with a common platform for sending and receiving messages. It is based on AMQP, an Open Standard for Messaging Middleware. Common use cases are publish/subscribe, asynchronous processing and work queues.

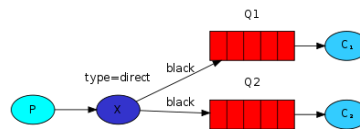


Figure 19: RabbitMQ principle example. Source: [38]

In this project it is used for passing commands to send e-mails to other background processes in order to speed up response times of the application.

5.5 HTML5

HTML5 is one of the biggest steps forward in web design and usability. It enhances web browser with functionality independent of 3rd party plugins such as Flash or Java: local storage, audio and video media content, geolocation, web workers and many others [37]. It also adds more semantics to the markup and extends form input types along with validation.

5.6 Other technologies

For PHP dependency management is used Composer⁹. It allows to declare the libraries and packages the project depends on and install or update the dependencies. It uses JSON format for declaring the dependencies.

⁷<https://mariadb.org/>

⁸<https://www.rabbitmq.com/>

⁹<https://getcomposer.org/>

Similarly Bower¹⁰ package manager is used for JavaScript, CSS or even font and image dependencies. It uses JSON format for configuration as well. Bower itself is runs on Node.js¹¹, a JavaScript runtime.

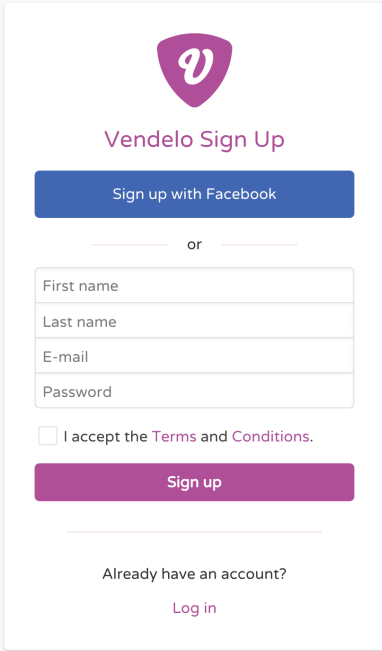
¹⁰<http://bower.io/>

¹¹<https://nodejs.org/en/>

6 Implementation

This chapter describes solutions to the challenging or interesting parts of the system.

6.1 Registration



The image shows a 'Vendelo Sign Up' form. At the top is a purple shield logo with a white 'V'. Below the logo is the title 'Vendelo Sign Up'. There is a blue button labeled 'Sign up with Facebook'. Below this is a horizontal line with the word 'or' in the center. Underneath are four input fields: 'First name', 'Last name', 'E-mail', and 'Password'. Below the input fields is a checkbox labeled 'I accept the Terms and Conditions.' followed by a link to 'Terms and Conditions'. Below the checkbox is a purple button labeled 'Sign up'. At the bottom of the form, there is a link 'Already have an account?' followed by a link 'Log in'. At the very bottom of the page, there is a small copyright notice: 'Vendelo Latin America, S.A. © 2016'.

Figure 20: Account - Registration

The registration is a good example of how RabbitMQ message queuing can be used. In this case it is used for asynchronous submission of confirmation e-mail. For an easy integration of RabbitMQ into Nette, the library Kdyby/RabbitMQ¹² was used.

The registration page displays two methods of registration: via e-mail and via Facebook. No matter what method a user chooses, the whole registration process is managed in a `RegistrationService` class.

```
class RegistrationService extends Nette\Object
{
    public function isEmailRegistered(Email $email);

    public function registerViaEmail($firstname, $lastname, Email $email,
        $password);
}
```

¹²<https://github.com/kdyby/rabbitmq>

```

public function complete($token);

public function registerViaFacebook($fbid, ArrayHash $user);
}

```

Listing 1: RegistrationService class declaration

When e-mail registration is chosen, registration form checks that given e-mail was not already taken by calling `RegistrationService::isEmailRegistered(Email $email):`

```

public function isEmailRegistered(Email $email)
{
    return $this->userRepository->getByEmail($email) !== NULL;
}

```

Listing 2: RegistrationService::isEmailRegistered definition (simplified)

If e-mail was not taken, user is then registered:

```

public function registerViaEmail($firstname, $lastname, Email $email,
    $password)
{
    try {
        $person = $this->personService->createNewPerson($firstname, $lastname,
            $email);
        $user = User::createForEmailRegistration($person, $password);
        $this->setupDefaultRoles($user);
        $reset = new PasswordReset($user);

        $this->onNewRegistration($email, $reset->getToken());

        return TRUE;
    } catch (\Exception $e) {
        return FALSE;
    }
}

```

Listing 3: RegistrationService::registerViaEmail definition (simplified)

On successful registration an event is triggered (note the `$this->onNewRegistration($email, $reset->getToken());`). This event is awaited by `NewRegistrationListener` which wraps up its arguments into a DTO and passes in into a queue:

```

public function onNewRegistration(Email $email, Token $token)
{
    $producer = $this->mq->getProducer('registration');
    $serialized = serialize(new RegistrationArgs($email, $token));
    $producer->publish($serialized, 'registration');
}

```

Listing 4: onNewRegistration event handler

A message queue is managed by a RegistrationMailer:

```

public function process(AMQPMessage $msg)
{
    $message = new \Nette\Mail\Message();
    $message->setFrom('jur0229@vsb.cz');
    $message->setSubject('Vendelo registration complete');

    /** @var RegistrationArgs $class */
    $class = unserialize($msg->body);

    /** @var RegistrationArgs $class */
    $message->addTo((string) $class->getEmail());

    $template = $this->templateFactory->createTemplate();
    $template->token = $class->getToken();

    $message->setHtmlBody($template);

    $this->mailer->send($message);
}

```

Listing 5: RegistrationMailer consumer (simplified)

Once the user clicks a link in received e-mail, his/her address gets confirmed and he/she is successfully registered.

Registration via Facebook proceeds as follows: user gets redirected to Facebook page with request to confirm application's request to access his/her information (currently we require only his/her public data and an e-mail). Once he/she approves our request, he/she gets redirected back to the application where obtained information are processed in

```
RegistrationService::registerViaFacebook($fbid, ArrayHash $user):
```

```

public function registerViaEmail($firstname, $lastname, Email $email,
    $password)
{
    try {
        $person = $this->personService->createNewPerson($user->first_name,
            $user->last_name, $user->email);
        $user = User::createForFacebookRegistration($person, $fbid);
        $this->setupDefaultRoles($user);

        return $user;
    } catch (\Exception $e) {
        return FALSE;
    }
}

```

Listing 6: RegistrationService::registerViaFacebook definition (simplified)

User's e-mail is already verified by Facebook so user is immediately logged in without a need of any action from his/her side.

6.2 Create Advertisement - Multi-step process

As the process of creating a new Advertisement consists of four steps, there must be a way to keep track of the information provided in every step and of the order they are shown. For this purpose a class **Wizzard** was created.

Wizzard is a component (reusable and renderable class) [36] that accepts other components and renders them in given order. An example of configuring such Wizzard follows:

```

wizzard:
  steps:
    -
      name: 'Category'
      class: App\AccountModule\AdminModule\CategorySelector
    -
      name: 'Region'
      class: App\AccountModule\AdminModule\RegionSelector
    -
      name: 'Details'
      class: App\AccountModule\AdminModule\
        AdvertisementFormFactoryWizzardWrapper
    -

```

```
name: 'Photos'
class: App\AccountModule\AdminModule\GalleryWizzardWrapper
```

Listing 7: Wizzard configuration

Name denotes what will be displayed in navigation of the Wizzard and class specifies what class will be rendered in given step.

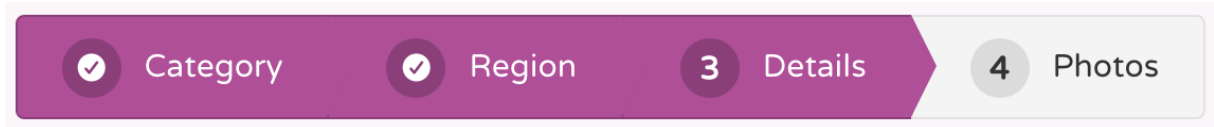


Figure 21: Wizzard - navigation

In current implementation subcomponents must be aware of its parent and pass its data to this parent by calling single method (Note that data might be of any kind, but it must be serializable.):

```
$this->parent->setValues($this->name, $data);
```

Listing 8: Passing data from subcomponent to Wizzard

6.3 Category tree management

Categories form simple tree structure that serves for logical classification of the Advertisements. A category only defines its name, optional pictogram, optional parent and a list of children. In reality the Advertisements are always related to the leaves of the tree only. Moreover such leaves must define Subject class that is used for determining what form to use when a new classified is to be created in given category, how it is mapped to an entity and how its detail is displayed. This is achieved by the new class SubjectDefinition extending the class Category.

Before adding a new category to the tree, duplicity of the same name under the same parent is checked. It is achieved by listener on Doctrine event before persisting an entity to the database.

```
$found = $categories->findBy([
    'translations.name' => $category->getName(),
    'parent' => $category->getParent(),
]);

if ($found) {
    throw new DuplicateEntryException("Category '". $category->getName(). "'
    already exists.");
}
```

Listing 9: Checking duplicate categories under the same parent (simplified)

6.4 Subjects

Details of individual Subject types vary and there are many ways to approach such situation. The first one is to implement administrative interface for composing forms and storing their footprints into the database and then build them on demand or build them right away and attached the form instance to the Subject. Such approach is unfortunately inappropriate as these forms might be very complex and development of this interface would be time demanding. The second one is to prepare all necessary forms and their mappings to the database programmatically. Each Subject has its own Persister class that manages transfer from form to the entity. This approach requires a programmer to carry out any change in the code, on the other hand we have full control over the process and it is relatively fast to execute compared to the first solution. Under those circumstances the second option was chosen.

There is a factory for creating the appropriate form for given category:

```
public function create(SubjectDefinition $category)
{
    $class = $category->getSubjectClass();
    $class = __NAMESPACE__ . '\\'. substr($class, strrpos($class, '\\')+1) . 'Form'
        . ' ';

    $instance = $this->container->createInstance($class, [$category]);

    if ($instance instanceof ITranslatable) {
        $instance->setTranslator($this->container->getByType(ITranslator::class))
        ;
    }
    return $instance;
}
```

Listing 10: Factory for creating a form based on category

Similarly there is a factory for creating the appropriate persister for given category:

```
public function create(SubjectDefinition $category)
{
    $class = $category->getSubjectClass();
    $class = __NAMESPACE__ . '\\'. substr($class, strrpos($class, '\\')+1) . '
        Persister';

    return $this->container->createInstance($class, [$this->locale]);
}
```

Listing 11: Factory for creating a persister based on category

In order to create a fully functional Subject it is necessary to implement an entity describing the subject, a form that enables users to provide given information, a persister that transfers data from the form to the entity and a Subject detail that defines how to display the Subject.

6.5 UI

The design of the application is based on modern CSS framework Bourbon¹³ and Neat¹⁴. Custom styles are written in SASS¹⁵ and compiled into CSS. SASS provides many useful extensions to CSS such as variables, mixins, functions, and many others. Neat framework allows the application to be responsive to the screen resolution and so mobile users are not limited and may have the same experience as tablet and computer users [39].

The new HTML5 input types are used where applicable. Thanks to support by new browsers both in computer and mobile devices it is more comfortable to provide e.g. numbers, e-mails or dates as mobile devices can display different keyboards for given input types. [40]

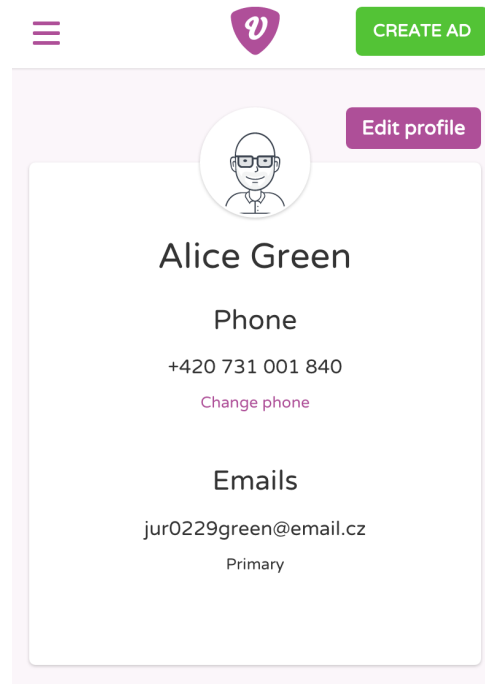


Figure 22: Responsive layout on mobile devices

¹³<http://bourbon.io/>

¹⁴<http://neat.bourbon.io/>

¹⁵<http://sass-lang.com/>

7 Evaluation and further development

Resulting developed system allows clients to register and login via e-mail or via Facebook, manage their own classifieds and read messages received from visitors. Both clients and visitors can browse through published classifieds, filter them by price, title, age and by existence of a photo gallery. This system is intended for deployment on the South American market.

The project is a solid foundation for further development, implementation of advanced features and implementation of a business model:

First, there are only Subjects for the Real estates category. There are many Subjects to be implemented. Other categories to be implemented are Cars, Jobs and Electronics.

Second, business accounts. Currently businesses that would advertise on this developed server would not have any added value compared to other consumer advertisers. There is a big opportunity to implement a business account with multiple users with defined roles. There will be at least one owner that can manage all other users and see their activities. Other users will be able to add classifieds on behalf of the business. Other allowed activities will be based on permissions granted by the owners.

Third, monetization. Based on the research, it is plausible to combine two approaches: monthly subscription on an account that enables extensive publication of classifieds with certain advantages such as more photos in a gallery etc. and individual payments for promoting the position of classifieds.

Fourth, optimization. Internet application such as adverting server manipulates with many data. When the server has high traffic it can easily get overloaded. To avoid such situation there are many ways to improve application's performance: horizontal scaling when more application server and/or database servers are added to the infrastructure with preservation of currently used technologies, or using different technologies with better performance. There are several candidates for new technologies such as Memcached¹⁶ or Redis¹⁷ for caching and Elastic¹⁸ for fast data retrieval.

¹⁶<https://memcached.org/>

¹⁷<http://redis.io/>

¹⁸<https://www.elastic.co/>

8 Conclusion

The purpose of this bachelor thesis was to design and implement an advertising server based on knowledge obtained from the market research both in the Czech Republic and abroad. The server operates as a meeting place of sellers and buyers in order to get rid of needless objects in case of personal classifieds or to advertise a service or a product in case of a business classifieds.

In theoretical part I defined common terms in e-commerce, did a market research of Czech and foreign advertising servers, evaluated their features, strong and weak aspects and business models as well as market share of the servers. Those observations were used during design and implementation of the system. In the design phase I pointed out requirements put on the system and its overall structure. I dedicated a chapter to technologies I decided to use in implementation phase. Then I described how the system works in its current form. Last chapter discusses potential of further development of the system.

The result of practical part is a proof of concept describing how the system may support multiple categories of classifieds implementing just a few classes. Currently the system has implemented several subjects in Real estates category. During development I deepened my knowledge about Nette framework and Doctrine ORM and learned basics of using a new technology RabbitMQ.

References

- [1] ZÁVODSKÁ, Lucie *Klíčové aspekty rozhodování firmy o vstupu do e-businessu* [online]. Jindřichův Hradec, 2010. 14 s. Master thesis on Faculty of management, University of economics in Jindřichův Hradec, Department of Management. Thesis supervisor Ing. Tomáš Kincl, PhD. URL: https://isis.vse.cz/lide/clovek.pl?zalozka=13;id=57037;studium=83478;zp=20918;download_prace=1
- [2] Amazon.com (*AMZN*) *Enterprise Value* [online]. April 8, 2016. URL: https://ycharts.com/companies/AMZN/enterprise_value
- [3] netdevelo s.r.o. *Malý historický exkurz za prvními e-shopy* [online]. 26. 3. 2010 URL: <https://www.shopsys.cz/clanky/maly-historicky-exkurz-za-prvnimi-eshopy/>
- [4] Avízo, a.s. *O nás* [online]. URL: <http://napoveda.avizo.cz/o-nas/>
- [5] Heureka Shopping s.r.o. *About us* [online]. URL: <http://aboutus.heureka.cz/about-us>
- [6] Association for e-commerce *Česká e-komerce v roce 2015 předčila očekávání, růst se nezas-taví ani v roce 2016* [online]. January, 7 2016. URL: <https://www.apek.cz/clanky/ceska-e-komerce-v-roce-2015-predcila-ocekavani-ru>
- [7] Podnikátor *Co jsou zkratky B2C, B2B, B2G, B2E* [online]. URL: <http://www.podnikator.cz/provoz-firmy/marketing/n:16260/Co-jsou-zkratky-B2C-B2B-B2G-B2E>
- [8] KAPLAN, Marcia *B2B Ecommerce Growing; Becoming More Like B2C* [online]. April 9, 2015. URL: <http://www.practicalecommerce.com/articles/85970-B2B-Ecommerce-Growing-Becoming-More-Like-B2C>
- [9] HOM, Elaine J. *What is C2C?* [online]. September 11, 2013. URL: <http://www.businessnewsdaily.com/5084-what-is-c2c.html>
- [10] ARLINE, Katherine *What is C2B?* [online]. January 2, 2015. URL: <http://www.businessnewsdaily.com/5001-what-is-c2b.html>
- [11] Allegro Group CZ, s.r.o. *O nás* [online]. URL: <http://info.aukro.cz/about/>
- [12] Allegro Group CZ, s.r.o. *Vydělávejte prodejem na Aukru* [online]. URL: <http://prodej.aukro.cz/>
- [13] NetMonitor *Public report for January 2016* [online]. URL: <http://www.netmonitor.cz/verejne-vystupy>
- [14] Allegro Group CZ, s.r.o. *Podnikatelský účet* [online]. URL: <http://faq.aukro.cz/19009/18993/19709/soukromy-nebo-podnikatelsky-ucet>

- [15] Allegro Group CZ, s.r.o. *Top zboží na Aukro* [online]. URL: http://prodej.aukro.cz/files/Co_se_nejvic_prodava_na_Aukru.pdf
- [16] Allegro Group CZ, s.r.o. *Vlastní e-shop vs. Aukro* [online]. URL: http://prodej.aukro.cz/files/Aukro-vs-eshop_01.pdf
- [17] Allegro Group CZ, s.r.o. *WebAPI* [online]. URL: <http://faq.aukro.cz/23419/19041/19935/co-je-webapi>
- [18] Allegro Group CZ, s.r.o. *Manažer prodeje* [online]. URL: <http://faq.aukro.cz/19101/22871/20091/co-je-manazer-prodeje-jak-sluzbu-aktivovat>
- [19] Allegro Group CZ, s.r.o. *Aukro Shopy* [online]. URL: <http://faq.aukro.cz/19065/19041/aukro-shopy>
- [20] Allegro Group CZ, s.r.o. *Průvodce nákupem* [online]. URL: <http://info.aukro.cz/sluzby/>
- [21] Allegro Group CZ, s.r.o. *Aukro Smlouva* [online]. URL: http://aukro.cz/country_pages/56/0/z4_updated.php
- [22] Allegro Group CZ, s.r.o. *Aukro Shopy - Ceník pro Aukro Shopy* [online]. URL: <http://faq.aukro.cz/19065/19041/19587/cenik-pro-aukro-shopy>
- [23] AVÍZO, a.s. *Avízo - Homepage* [online]. URL: <http://www.avizo.cz/>
- [24] AVÍZO, a.s. *Provozní podmínky* [online]. URL: <http://napoveda.avizo.cz/provozni-podminky/>
- [25] AVÍZO, a.s. *Proč se registrovat* [online]. URL: <http://napoveda.avizo.cz/registrace-a-jeji-vyhody/>
- [26] AVÍZO, a.s. *Ceník inzerce* [online]. URL: <http://napoveda.avizo.cz/inzerce/>
- [27] AVÍZO, a.s. *Zvýhodněné balíčky inzerce* [online]. URL: <http://napoveda.avizo.cz/c/balicky/>
- [28] HyperMedia, a.s. *HyperInzerce* [online]. URL: <http://www.hypermedia.cz/media/detail-webu/245>
- [29] ANNOUNCE a.s. *O Annonci* [online]. URL: <http://www.annonce.cz/o-annonci/>
- [30] OLX *About OLX* [online]. URL: <https://www.olx.com.pa/help/about?language=en-US>
- [31] SKVORC, Bruno. *The Best PHP Framework for 2015: SitePoint Survey Results* [online]. March 30, 2015. URL: <http://www.sitepoint.com/best-php-framework-2015-sitepoint-survey-results/>
- [32] KUDĚLKA, Miloš. *Vývoj informačních systémů: Architektura, návrh* [online]. URL: <http://homel.vsb.cz/kud007/files/vis2.pdf>

- [33] Nette Community *Vulnerability Protection* [online]. URL: <https://doc.nette.org/en/2.3/vulnerability-protection>
- [34] ŠTRAUCH, Adam *Databáze MariaDB válcuje MySQL* [online]. URL: <http://www.root.cz/clanky/databaze-mariadb-valcuje-mysql/>
- [35] Alexa *Top Sites in Panama* [online]. April 16, 2016. URL: <http://www.alexa.com/topsites/countries/PA>
- [36] Nette Community *Components* [online]. April 17, 2016. URL: <https://doc.nette.org/en/2.3/components>
- [37] NIXON, Robin *Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5*. 4th edition, O'Reilly, 2014, page 557, ISBN: 978-1491918661
- [38] URL: <https://rabbitmq.com/tutorials/tutorial-four-php.html>
- [39] BEAIRD, Jason *The Principles of Beautiful Web Design* SitePoint, 2014, page 34. ISBN: 978-0992279448
- [40] VODNIK, Sasha *HTML5 and CSS3, Illustrated Complete* Course Technology, 2015, page 235. ISBN: 978-1305394049

A List of contents - CD

bachelor-thesis.pdf	- bachelor thesis
Screenshots/	- full size screenshots
Project/	- practical part
data/	- SQL scripts
src/	- source codes
app/	- application source codes
lib/	- other PHP dependencies
vendor/	- Composer managed PHP dependencies
www/	- JS, CSS and other assets